

**PLAGIOGNATHUS REINHARDI JOHNSTON (HEMIPTERA: MIRIDAE):  
DISTRIBUTION, HABITS, AND SEASONALITY OF A HAWTHORN  
(CRATAEGUS) SPECIALIST**

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*Abstract.*—The phyline plant bug *Plagiognathus reinhardi* Johnston, described from Texas in 1935, has been known only from the type locality (College Station). Recent fieldwork produced the first records of this species for the southeastern United States. This mirid developed on glandular hawthorns (*Crataegus* sp.[p.]; Rosaceae) of series *Lachrimatae*, mainly in the fall-line sandhills from southern North Carolina through South Carolina and Georgia to eastern Alabama but also in disturbed sandhills in the panhandle and northern peninsula of Florida. Overwintered eggs hatched near vegetative budbreak of host hawthorns; late February to early March in Florida and mid-March in South Carolina. Early instars were found on the expanding leaves, whereas late instars were associated mainly with flower buds and inflorescences. Adults appeared by mid- or late March in Florida and mid-April in South Carolina. Adults of this univoltine mirid were present for about four to six weeks, the females persisting longer than the males.

*Key Words:* Insecta, Miridae, insect distribution, seasonal history, *Crataegus*, fall-line sandhills

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Johnston (1935) described the phyline plant bug *Plagiognathus reinhardi* from College Station, Texas. The type series consisted of 80 males and females collected on hawthorn, *Crataegus* sp. (Rosaceae), from March 29 to April 21, 1933. No further records of this distinctive dark red or reddish-brown mirid have been published since the original description (Henry and Wheeler 1988). Schuh (2001) stated that it is found in the southern United States but did not cite additional records. This plant bug's sexually dimorphic second antennomere and structure of the male vesica (see Schuh [2001]; fig. 40) do not conform to the current concept of the genus *Plagiognathus*. This species, therefore, was given the status of *incertae sedis* by Schuh (2001). Here I record *P. reinhardi* from the southeastern

United States, cite an additional Texas record, and provide notes on its seasonal history and habits.

#### METHODS AND STUDY SITES

I discovered *P. reinhardi* in South Carolina in 1988, but surveys to learn more about its southeastern distribution were not initiated until 1999. *Crataegus* spp. in the fall-line sandhills from southern North Carolina to eastern Alabama were sampled during 1999–2001 by tapping branches over a shallow net. Sampling also was conducted in northern Florida in 2000–2002. At each site where adults were found, one or more specimens were collected and deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

During March–May 2000–2001, haw-

thorns in the fall-line sandhills of South Carolina were sampled to determine when the overwintered eggs of *P. reinhardi* begin to hatch, when the adults begin to appear, and the period of time they are present. The main study site was a disturbed sandhill in Richland County, 2.5 km southwest of Pontiac. The approximate time of egg hatch and the period of adult occurrence also were determined at several sites in the northern peninsula of Florida (see Distribution for specific localities). The number of individuals observed on each sample date varied but generally was <20. Early instars were particularly difficult to find because they were not easily dislodged from partially closed vegetative buds. Only limited numbers (<10) of nymphs typically were observed when overwintered eggs were beginning to hatch. First and second instars were collected, placed in 70% ethanol, and sorted to stage in the laboratory using a binocular microscope; later instars were identified in the field and their relative proportions estimated.

#### DISTRIBUTION (Fig. 1)

In the following list of new records for *P. reinhardi*, those based only on nymphs are indicated as "(n)." All collections were from *Crataegus* (for comments on identification of the host, see Habitats and Host Plants) by the author, except the one from Texas and those from Washington County, Florida.

ALABAMA: Russell Co., Rt. 165, 5 km N of Fort Mitchell, 32°23.1'N, 85°02.2'W, 9 Apr. 2000 (3 ♂, 1 ♀); Rt. 165, 4 km N of Holy Trinity, 32°15.5'N, 85°00.1'W, 9 Apr. 2000 (n); Rt. 169, 1.5 km NW jct. Rt. 431, NNW of Seale, 32°19.6'N, 85°10.5'W, 9 Apr. 2000 (n). FLORIDA: Alachua Co., Rt. 441, 1.7 km NW of High Springs, 29°50.2'N, 82°36.1'W, 3 Mar. 2000 (n) and 22 Mar. 2000 (6 ♂, 5 ♀), 19 Mar. 2002 (n); Columbia Co., Ichetucknee Springs State Park, ca. 6.5 km NW of Fort White, 29°57.5'N, 82°46.0'W, 3 Mar. 2000 (n) and

22 Mar. 2000 (20 ♂, 6 ♀), 2 Mar. 2001 (n) and 17 Mar. 2001 (10 ♂, 2 ♀), 19 Mar. 2002 (n); Hamilton Co., Rt. 129, ca. 4 km NW of Jasper, 30°32.6'N, 82°58.4'W, 23 Mar. 2000 (n); Rt. 129, 0.7 km N of Suwannee River, NE of Suwannee Springs, 30°23.8'N, 82°56.1'W, 23 Mar. 2000 (n); Suwannee Co., Rt. 27, 5 km E of Branford, 29°57.1'N, 82°52.6'W, 3 Mar. 2000 (n); jct. Rts. 75 & 136, 4.6 km SW of White Springs, 30°19.2'N, 82°48.4'W, 21 Mar. 2000 (n); Washington Co., Rt. 279, 7 km N of Greenhead & jct. Rt. 77, 30°34.6'N, 85°40.1'W, 19 Apr. 2001, T. J. Henry & A. G. Wheeler, Jr. (1 ♂, 1 ♀); Rt. 79, 2.4 km S of New Hope, 30°33'17"N, 85°49'14"W, 19 Apr. 2001, T. J. Henry & A. G. Wheeler, Jr. (1 ♂). GEORGIA: Chattahoochee Co., Rt. 26, 1 km N of Cusseta, 32°18.9'N, 84°46.4'W, 9 Apr. 2000 (3 ♂, 1 ♀); Crawford Co., Rt. 96, 0.5 km E of Flint River, 8.2 km E of Reynolds, 32°32.8'N, 84°00.7'W, 9 Apr. 2000 (n); Crisp Co., Rt. 257, 1.3 km SW of Dooly Co. line, 0.8 km SW of Lambtown, 32°01.3'N, 83°5.5'W, 21 Apr. 2001 (2 ♀); Glascock Co., Rt. 123, 0.1 km NNW of Mitchell, 33°13.2'N, 82°42.3'W, 18 May 1999 (1 ♀); Jefferson Co., Rt. 221, 9.8 km N of Wrens, 33°18.7'N, 82°22.7'W, 18 May 1999 (4 ♂, 8 ♀); Jones Co., Rt. 129, 3.8 km NE of Gray, 33°02.4'N, 83°30.7'W, 9 Apr. 2000 (n); McDuffie Co., CR-86 nr jct. CR SE 75, 2.5 km W of Dearing, 33°25.5'N, 82°24.6'W, 18 May 1999 (3 ♂, 3 ♀); Ellington Airline Rd., 3 km SW of Dearing, 33°24.1'N, 82°24.9'W, 1 Apr. 2000 (n); Marion Co., jct. Rts. 41 & 127, 14 km N of Buena Vista, 32°26.4'N, 84°32.1'W, 8 Apr. 1997 (adults, sex unknown) and 9 Apr. 2000 (n); Oconee Co., Rt. 129, 0.5 km SW of Farmington, 33°46.4'N, 83°25.6'W, 9 Apr. (n) & 20 Apr. 2000 (n, 3 ♂ reared); Pulaski Co., Rt. 129A, Hartford community NE of Hawkinsville, 32°17.1'N, 83°26.9'W, 21 Apr. 2001 (3 ♂, 8 ♀); Richmond Co., Wheeler Rd., Augusta, 33°28.9'N, 82°05.2'W, 18 May 1999 (2 ♀); Stewart Co., Rt. 39, 4 km E of Omaha, 32°08.3'N,

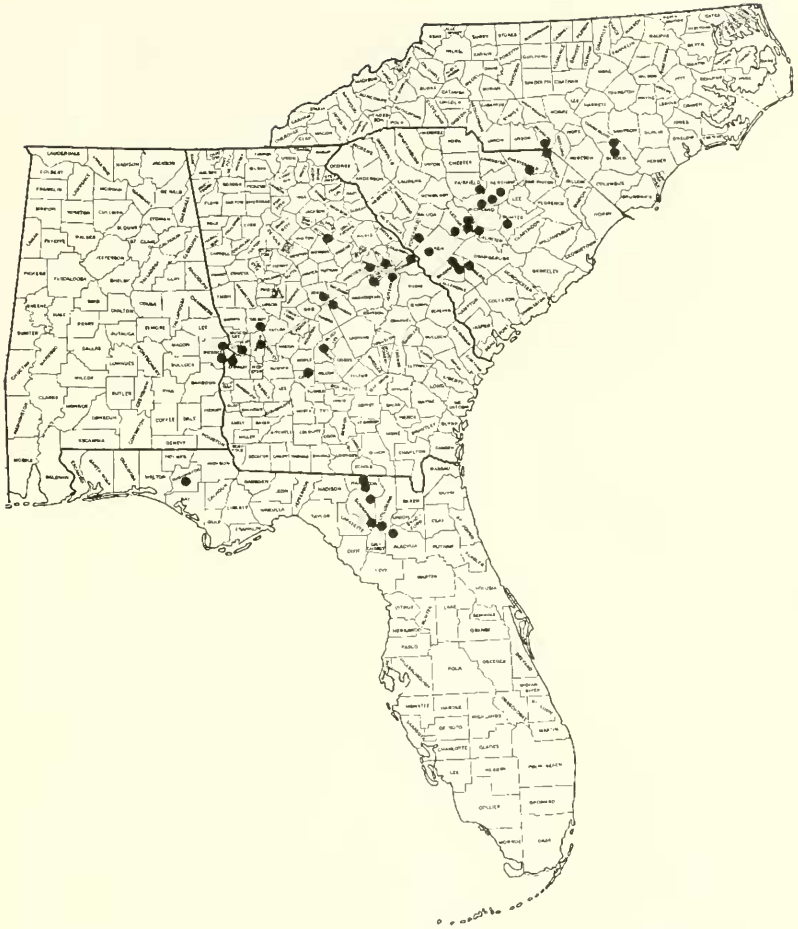


Fig. 1. New distribution records of *Plagiognathus reinhardi* in the southeastern United States (Alabama, Florida, Georgia, North Carolina, South Carolina). Note: See Distribution for more precise locations of collection sites and for a new Texas record.

84°58.3'W, 9 Apr. 2000 (n); Talbot Co., Rt. 90, S of Junction City. 32°35.1'N, 84°26.8'W, 15 Apr. 1990 (n); Rt. 96, Junction City, 32°36.3'N, 84°27.7'W, 9 Apr. 2000 (3 ♂, 1 ♀); Warren Co., Rt. 123, 3.6 km S of jct. Rt. 16, SSW of Warrenton,

33°16.0'N, 82°45.2'W, 18 May 1999 (2 ♂, 15 ♀); Wilkinson Co., Rt. 18, 6.1 km S of Gordon, 32°50.4'N, 83°20.0'W, 21 Apr. 2001 (5 ♂, 4 ♀). NORTH CAROLINA: Bladen Co., Rt. 242, 14 km N of Elizabethtown, 34°45.9'N, 78°36.4'W, 23 May

1999 (1 ♂, 3 ♀); Cumberland Co., Rt. 242, 1.9 km S of jct. 210, 4.5 km NNE of Ammon, 34°22.0'N, 78°33.1'W, 23 May 1999 (1 ♂, 4 ♀); Richmond Co., Rt. 177, 1.1 km NE of Hamlet, 34°54.4'N, 79°41.1'W, 22 May 1999 (5 ♂, 17 ♀); Rt. 177, 0.3 km S of Osborne, 34°45.5'N, 79°46.2'W, 23 May 1999 (3 ♀). SOUTH CAROLINA: Aiken Co., Henderson Heritage Preserve, ca. 6 km NW of Aiken, 33°36.3'N, 81°45.2'W, 24 Apr. 1998 (1 ♀) & 16 Apr. 2000 (n); North Augusta, 33°30.3'N, 81°57.9'W, 11 Mar. & 7 Apr. 2001 (n); Bamberg Co., Rt. 321, 3.8 km N of Denmark, 33°21.6'N, 81°08.2'W, 31 Mar. 2001 and 7 Apr. 2001 (n); Barnwell Co., Rt. 39, 2.5 km SSE of jct. Rt. 78, SE of Williston, 33°23.2'N, 81°26.7'W, 31 Mar. 2001 (n); Rt. 78, 6.4 km W of Blackville, 33°22.3'N, 81°20.3'W, 7 Apr. 2001 (n); Calhoun Co., co. rd. 31 E of jct. Rt. 26, ca. 4 km NW of Sandy Run, 33°48.6'N, 81°00.4'W, 20 May 2001 (1 ♀); Rt. 176, 5 km SE of Sandy Run, 33°46.3'N, 80°55.5'W, 20 May 2000 (1 ♀); Chesterfield Co., jct. Rts. 1 & SR-13-29, 4.3 km NE of Middendorf, 34°32.6'N, 80°07.4'W, 22 May 1999 (1 ♂, 8 ♀); Edgefield Co., S-19-407 nr. jct. S-19-37, ca. 8.5 km SW of Eureka, 33°39.5'N, 81°51.6'W, 18 May 1999 (1 ♂, 15 ♀), 6 June 1999 (1 ♀), 12 May 2001 (1 ♂, 5 ♀); jct. Rt. 25 & Whitlock Rd., 8.8 km SSW of Trenton, 33°40.0'N, 81°52.4'W, 18 May 1999 (1 ♂, 3 ♀); Fairfield Co., Rt. 34, 0.6 km W of Kershaw Co. line, 12.6 km SSE of Ridge-way, 34°16.4'N, 80°49.9'W, 20 May 2000 (1 ♂, 2 ♀); Kershaw Co., jct. S-28-47 & S-28-367, ca. 3.8 km SE of Elgin, 34°09.1'N, 80°45.7'W, 22 May 1999 (2 ♂, 8 ♀); Rt. 1, ca. 8.5 km NE of Camden, 34°18.8'N, 80°32.4'W, 22 May 1999 (2 ♀); Lexington Co., Rt. 302, S of Cayce, 13 May 1988 (1 ♀); jct. Rt. 178 and Gantt Mill Rd., 7.5 km W of Pelion, 33°45.3'N, 81°19.7'W, 6 May 1989 (2 adults, sex unknown); Rt. 321, 0.8 km S of jct. S-32-952, 33°48.4'N, 81°05.8'W, Gaston, 11 & 31 Mar. 2001 (n); Rt. 321, 3 km N of Gaston, 33°50.3'N, 81°05.3'W, 26 Apr. 1998 (1 ♂,

1 ♀); Peachtree Rock Preserve, 3.5 km SE of Edmund, 33°49.9'N, 81°12.0'W, 26 May 1995 (2 ♀), 7 Apr. (n) & 28 Apr. 2001 (4 ♂, 1 ♀); Marlboro Co., Rt. 177, 0.9 km S of Fulton, 34°46.2'N, 79°47.7'W, 23 May 1999 (2 ♂, 6 ♀); Richland Co., Valhalla Dr., 0.1 km S of Rt. 1, 2.5 km SW of Pontiac, 34°07.0'N, 80°52.8'W, 15 May (9 ♂, 6 ♀), 22 May (1 ♂, 10 ♀) & 26 May 1999 (2 ♀); 16 Apr. (2 ♀), 6 May (4 ♂, 6 ♀), & 20 May 2000 (10 ♀); Sumter Co., Rt. 261, Manchester State Forest, 4.7 km S of Wedgefield, 33°51.5'N, 80°31.0'W, 26 May 1999 (1 ♀).

TEXAS: Victoria Co., Rt. 59, 9 km NE of Inez, 28°56.5'N, 96°42.5'W, 18 Apr. 1983, T. J. Henry & A. G. Wheeler, Jr. (adults, sex unknown).

#### HABITATS AND HOST PLANTS

*Plagiognathus reinhardi* was found mainly in the fall-line sandhills from southern North Carolina through South Carolina and Georgia to eastern Alabama, and in xeric sand communities in northern Florida. In South Carolina counties such as Edgefield and Fairfield, which lie mainly in the piedmont and contain a sliver of sandhills, this mirid was found only in the sandhills ecoregion. In Georgia, however, *P. reinhardi* was collected in the piedmont as far north as Oconee County (Fig. 1).

The host plant of *P. reinhardi* is a species of *Crataegus* (or complex of "microspecies" *sensu* Phipps 1988b) characteristic of xeric sand communities from southern North Carolina to eastern Alabama and northern Florida. This plant often is found in disturbed sites such as vacant lots, along highways, and railroad rights-of-way, and it is the most common hawthorn in the sandhills of South Carolina (Schoenike 1982). Belonging to the section (and series) *Lacrimatae* (Phipps et al. 1990), this taxon often is misidentified as *C. flava* Ait. (e.g., Duke 1961, Radford et al. 1968, Clark 1971, Clewell 1985, Godfrey 1988, Partridge et al. 2000; see also Phipps et al. 1990). *Crataegus flava*, however, is rare or



Fig. 2. Host plant of *Plagiognathus reinhardi*, a hawthorn of series *Lachrimatae* (probably *Crataegus alabamensis* or *C. meridiana*), in disturbed sandhills near Pontiac (Richland County), South Carolina.

even extinct in the wild, apparently is no longer in cultivation, belongs to another section of *Crataegus*, and has not been correctly identified subsequent to Beadle's (1903) treatment (Phipps 1988a, Phipps et al. 1990). In addition to *C. flava* sensu auctt. Amerr. non Ait., the common *Crataegus* species of southeastern sandhills has been referred to as *C. meridiana* Beadle (Coker and Totten 1945) and *C. michauxii* Pers. (e.g., Thorne 1954, Weakley 1997). Specific identifications in *Lachrimatae*, as in many other sections of *Crataegus*, are problematic. In many cases the original descriptions not only are insufficiently diagnostic to discriminate species, but type specimens, including those for taxa named from the southeastern states by C. D. Beadle and others, often are in poor condition or lacking. Apomixis and hybridization, as well as polyploidy, contribute to the "Crataegus problem" (e.g., Phipps 1988b, Phipps et al. 1990, Lance 1995).

The host of *P. reinhardi* at the sample site in Richland County, South Carolina, might be *C. alabamensis* Beadle or *C. meridiana* (Fig. 2). This plant is a shrub or small tree with a dense growth habit, pendulous branches at maturity, short and stout

thorns, twigs generally zigzag at the nodes, small leaves with their margins conspicuously gland dotted and white-tomentose above when young, petioles glandular; inflorescences compact and few flowered (generally 4–7 in cymes) with flowers small and the calyx lobes usually glandular-punctate, stamens 20; and fruit oval, yellow to red in clusters of 1–3, nutlets 2–5. Specimens from the main study site near Pontiac, South Carolina, labeled *Crataegus* aff. *alabamensis* Beadle by J. B. Phipps, 17 July 2000, and annotated to *C. meridiana* Beadle by R. Lance, 5 June 2002, are in the Clemson University Herbarium (CLEMS 55280; Townsend #2200).

The morphologically similar hosts of *P. reinhardi* in Alabama, Florida, Georgia, North Carolina, and at other sites in the South Carolina sandhills also belong to series *Lachrimatae* but may or may not be conspecific with what is thought to be *C. alabamensis* or *C. meridiana* in Richland County, South Carolina. Material from sample sites in Florida will key to *C. michauxii* in Godfrey (1988) and Wunderlin (1998). Other plants found consistently with *C. alabamensis* or *C. meridiana* (or other species of *Lachrimatae*) in disturbed

sandhills of South Carolina were American joint-weed, *Polygonella americana* (Fisch. & Mey.) Small (Polygonaceae); eastern prickly-pear, *Opuntia humifusa* (Raf.) Raf. (Cactaceae); longleaf pine, *Pinus palustris* Mill. (Pinaceae); silk-grass, *Pityopsis graminifolia* (Michx.) Nutt. (Asteraceae); and turkey oak, *Quercus laevis* Walter (Fagaceae).

#### SEASONALITY AND HABITS

In the South Carolina sandhills near Pontiac (Richland Co.), first instars were observed on 12 March 2000. No nymphs had been found on 26 February when vegetative buds were still tightly closed. Collections on 1 April consisted of one first, two third, two fourth, and two fifth instars. Populations on 16 April contained mostly fifth instars, with fourth instars and teneral adults also present. Only adults (4 ♂, 6 ♀) were found on 6 May, and only adult females ( $n = 10$ ) on 20 May. The latest record of *P. reinhardi* in South Carolina, a female from Edgefield County, was 6 June 1999.

In 2001, collections in South Carolina on 11 March consisted only of first instars at North Augusta (Aiken Co.) and Gaston (Lexington Co.). Second through fourth instars (predominately thirds) were observed at Gaston on 31 March, and fourth instars were collected on that date near Denmark in Bamberg County. Collections on 31 March in Aiken, Bamberg, and Barnwell counties consisted of third through fifth instars.

On 9 April 2000, adults (3 ♂, 1 ♀) were observed at one of three sites (north of Fort Mitchell) that were sampled in Russell County, Alabama, in the East Gulf Coastal Plain. Populations at all three Alabama sites consisted mainly of fourth and fifth instars, although a few second and third instars were present near Seale and a few third instars at the site north of Holy Trinity. Mirid populations in the East Gulf Coastal Plain of Georgia also consisted mainly of late instars and smaller numbers of teneral adults on 9 April 2000.

The populations of *P. reinhardi* sampled in northern Florida (Alachua, Columbia, and Suwannee counties) consisted of first and second instars on 3 March 2000. At Ichetucknee Springs State Park in Columbia County, adults (20 ♂, 6 ♀), many of them teneral, were present on 22 March with about equal numbers of late (fourth and fifth) instars. In 2001, development of this mirid on the single hawthorn that had been sampled the previous March in Ichetucknee Springs State Park was advanced compared to 2000; second through fourth instars were found on 2 March, indicating that egg hatch had begun by late February (no nymphs, however, were found on this same plant on 22 and 26 February 2002). Collections from this same plant on 17 March 2001 indicated that fifth instars were most numerous, with smaller numbers of fourth instars and mostly teneral adults (10 ♂, 2 ♀) also present. The population of *P. reinhardi* at Ichetucknee Springs State Park developed later in 2002 than in either of the two previous seasons; second through fourth instars were observed on 19 March. Extensive sampling on 14 April 2001 did not yield adults at the Alachua County site near High Springs, but small numbers of adults were still present in the panhandle (Washington Co.) on 19 April 2001.

First and second instars were found within unfolding leaves and presumably feed on the young foliage. Third through fifth instars were associated mainly with the flower buds and inflorescences of host hawthorns.

#### DISCUSSION

The phylina plant bug *P. reinhardi*, known previously only from the type locality in Texas, can be added to the fauna of the southeastern United States. A characteristic insect of the fall-line sandhills of Georgia, North Carolina, South Carolina, and eastern Alabama, it often is found in disturbed sites within pine-scrub oak sandhill communities. This mirid also can be found in disturbed sandhills in xeric sand communities of northern Florida. Arthro-

Pods associated with xeric longleaf pine habitats, which include sandhills, tend to be poorly known (Folkerts et al. 1993). The South Carolina sandhills, important for their biotic richness, provide habitats for numerous plant and animal species that are considered rare or endangered (e.g., Pittman 2001).

*Plagiognathus reinhardi* is a hawthorn specialist. The host plant in South Carolina apparently is *Crataegus alabamensis* or *C. meridiana*, a hawthorn with glandular leaf margins, petioles, and calyx lobes. This plant frequently is misidentified as *C. flava* Ait. Elsewhere, *P. reinhardi* also develops on glandular hawthorns of series *Lachrimatae*. The use of glandular host plants is common in the Miridae (see Wheeler 2001). *Plagiognathus reinhardi* was not found on nonglandular species of *Crataegus*, including *C. spathulata* Michx. growing in Oconee County, Georgia, within two meters of a glandular hawthorn that harbored nymphs of the mirid.

Overwintered eggs of this univoltine plant bug begin to hatch at or slightly after vegetative budbreak of their hosts. Egg hatch apparently begins about the second week of March in the South Carolina sandhills and, in some years, as early as late February in northern Florida. In South Carolina, adults appear by mid-April, with fifth instars sometimes present until late April. These nymphal "stragglers" usually are parasitized by a euphorine braconid. Adults begin to appear in northern Florida by about mid- to late March. The appearance of adults generally corresponds with the period of late bloom on host hawthorns. Adults are present only for four to six weeks. Late-season populations, like those of most Miridae (Wheeler 2001), are strongly female biased.

The only other phytophagous mirid that co-occurred with *P. reinhardi* on glandular hawthorns was the orthotyline *Heterocordylus malinus* Slingerland. It was observed at about half of the sites sampled in both Georgia and South Carolina and was pre-

sent at one of three sites sampled in Russell County, Alabama (new state record). *Heterocordylus malinus* is a univoltine plant bug whose seasonality in Alabama, Georgia, and South Carolina is similar to that of *P. reinhardi*, the overwintered eggs hatching by mid-March and adults appearing about a month later. Nymphs of *H. malinus* are red to reddish brown, whereas those of *P. reinhardi* are yellow to yellow green.

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#### LITERATURE CITED

- Beadle, C. D. 1903. *Crataegus*, pp. 532–569. In Small, J. K. Flora of the Southeastern United States. The author, New York.

- Clark, R. C. 1971. The woody plants of Alabama. *Annals of the Missouri Botanical Garden* 58: 99–242.
- Clewell, A. F. 1985. *Guide to the Vascular Plants of the Florida Panhandle*. University Presses of Florida, Tallahassee, 605 pp.
- Coker, W. C. and H. R. Totten. 1945. *Trees of the Southeastern United States, Including Virginia, North Carolina, South Carolina, Tennessee, Georgia, and Northern Florida*. University of North Carolina Press, Chapel Hill, 419 pp.
- Duke, J. A. 1961. The psammophytes of the Carolina fall-line sandhills. *Journal of the Elisha Mitchell Scientific Society* 77: 3–25.
- Folkerts, G. W., M. A. Deyrup, and D. C. Sisson. 1993. Arthropods associated with xeric longleaf pine habitats in the southeastern United States: A brief overview, pp. 159–192. *In Proceedings of the Tall Timbers Fire Ecology Conference No. 18, The Longleaf Pine Ecosystem: Ecology, Restoration and Management*, May 30–June 2, 1991. Tall Timbers Research Station, Tallahassee, Florida.
- Godfrey, R. K. 1988. *Trees, Shrubs, and Woody Vines of Northern Florida and Adjacent Georgia and Alabama*. University of Georgia Press, Athens, 734 pp.
- Henry, T. J. and A. G. Wheeler, Jr. 1988. Family Miridae Hahn, 1833 (= Capsidae Burmeister, 1835): The plant bugs, pp. 251–507. *In Henry, T. J. and R. C. Froeschner, eds. Catalog of the Heteroptera, or True Bugs, of Canada and the Continental United States*. E.J. Brill, Leiden.
- Johnston, H. G. 1935. Five new species of Miridae (Hemiptera). *Bulletin of the Brooklyn Entomological Society* 30: 15–19.
- Lance, R. 1995. *The Hawthorns of the Southeastern United States*. The author, Fletcher, North Carolina, 136 pp.
- Partridge, E. C., W. A. Baker, and G. Morgan-Jones. 2000. Notes on Hyphomycetes. LXXVII. A new species of *Ramichloridium*, *R. bacillisporum*, occurring on leaf glands of *Crataegus flava* in Alabama. *Mycotaxon* 75: 147–152.
- Phipps, J. B. 1988a. Re-assessment of *Crataegus flava* Aiton and its nomenclatural implications for the *Crataegus* serial name *flavae* (Loud.) Rehd. and its sectional equivalent. *Taxon* 37: 108–113.
- . 1988b. *Crataegus* (Maloideae, Rosaceae) of the southeastern United States. I. Introduction and series *Aestivales*. *Journal of the Arnold Arboretum* 69: 401–431.
- Phipps, J. B., K. R. Robertson, P. G. Smith, and J. R. Rohrer. 1990. A checklist of the subfamily Maloideae (Rosaceae). *Canadian Journal of Botany* 68: 2209–2269.
- Pittman, B. 2001. Sandhills fall line, pp. 21–25. *In Carswell, L. and P. Robinson, eds. Conserving South Carolina: Sustaining and Protecting our Natural Resources*. The Nature Conservancy, Columbia, South Carolina.
- Radford, A. E., H. E. Ahles, and C. R. Bell. 1968. *Manual of the Vascular Flora of the Carolinas*. University of North Carolina Press, Chapel Hill, 1183 pp.
- Schoenike, R. E. 1982. *A Dendrology of South Carolina Trees, Native and Introduced*, 3rd printing. Department of Forestry, Clemson University, Clemson, South Carolina, 288 pp. [unpublished manuscript, Cooper Library, Clemson University.]
- Schuh, R. T. 2001. Revision of New World *Plagiognathus* Fieber, with comments on the Palearctic fauna and the description of a new genus (Heteroptera: Miridae: Phyllinae). *Bulletin of the American Museum of Natural History* 266: 1–267.
- Thorne, R. F. 1954. The vascular plants of southwestern Georgia. *American Midland Naturalist* 52: 257–327.
- Weakley, A. S. 1997. *Flora of the Carolinas and Virginia: Working Draft of 21 July 1997*. The Nature Conservancy, Southeast Regional Office, Chapel Hill, North Carolina.
- Wheeler, A. G., Jr. 2001. *Biology of the Plant Bugs (Hemiptera: Miridae): Pests, Predators, Opportunists*. Cornell University Press, Ithaca, New York, 507 pp.
- Wunderlin, R. P. 1998. *Guide to the Vascular Plants of Florida*. University Press of Florida, Gainesville, 806 pp.